

PERCEPTIONS OF UTAH ALFALFA GROWERS ABOUT WILDLIFE DAMAGE TO THEIR HAY CROPS: IMPLICATIONS FOR MANAGING WILDLIFE ON PRIVATE LAND

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ABSTRACT.—We conducted a survey of Utah alfalfa (*Medicago sativa*) growers in 1993 to identify wildlife damage problems to hay crops. Such surveys can provide wildlife managers with important insights regarding landowners' wildlife damage management concerns and needs. Pocket gophers (*Thomomys* spp.) and mule deer (*Odocoileus hemionus*) were perceived by growers as causing the most damage. Respondents reported a total annual loss of \$350,000 or \$24.79/ha (2.8% of the total crop value) because of wildlife damage in alfalfa crops. Decreased hay quantity was the most frequently cited problem caused by wildlife. Compensation and incentive programs were preferred over assistance and information programs for managing wildlife damage in alfalfa crops.

Key words: wildlife damage perceptions, alfalfa growers, wildlife damage management, wildlife management.

Alfalfa is an important livestock forage. In 1994 over 58 million tons of alfalfa hay were harvested in the U.S. on 9,802,400 ha of privately owned land. This represents over 40% of the hay harvested as livestock forage (National Agricultural Statistics Service 1995).

Alfalfa hay is the most important cash crop grown in Utah. In 1994 Utah farmers harvested 2,205,000 tons of alfalfa on 210,000 ha of privately owned land. This crop was worth \$158 million (Gneiting 1994).

Rodents, lagomorphs, ungulates, and waterfowl can impact alfalfa production (Piper 1909, Sauer 1978, Luce et al. 1981, Dunn et al. 1982, Packam and Connolly 1992, Austin and Urness 1993, Conover 1994). Big game grazing of alfalfa during the growing season creates conflicts between growers and wildlife managers (Austin and Urness 1993).

Conflicts also may arise between landowners and wildlife managers because of differing perceptions about the extent of wildlife damage in cultivated crops. Farmers may feel that wildlife managers are unaware of the extent of crop losses caused by wildlife and hence are insensitive to their needs (Decker et al. 1984, Conover and Decker 1991). Crop owners' concerns about wildlife damage strongly affect how the agricultural community will respond to environmental issues and whether federal or state wildlife programs aimed at maintaining or

improving wildlife habitat on private property will succeed (Conover 1994).

There is consensus among professionals working for federal and state wildlife and agricultural agencies that wildlife damage reduces the profitability of U.S. agriculture (Conover and Decker 1991). Professionals agree that wildlife depredation has increased over time but disagree over the seriousness of the impact. Although the actual costs associated with wildlife depredation are difficult to estimate and can differ on each farm or ranch and crop type (Tebaldi and Anderson 1982, Austin and Urness 1987a, 1987b, 1989, 1993, Lewis and O'Brien 1990), landowners have demonstrated an ability to accurately assess crop losses caused by wildlife (Decker et al. 1984, Conover 1994, McIvor and Conover 1994a). Crop losses and potential future losses caused by, or related to, the presence of wildlife must be assessed to determine if control is warranted (Rennison and Buckle 1988).

Several Great Basin states including Utah, Wyoming, Colorado, New Mexico, Nevada, Idaho, and Arizona have enacted laws to compensate crop owners for wildlife-caused damage (Musgrave and Stein 1993). These actions have been initiated largely in response to constituent concerns over the economic impact of depredating wildlife, particularly big game, in cultivated crops.

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Crop owners in Utah may destroy depre-dating big game animals if the animals are not removed by the Utah Division of Wildlife Resources (UDWR) within 72 h of notification (Chapter 183, Utah Code 1993a). Utah crop owners also may receive monetary compensa-tion for damage caused by big game animals (Chapter 307, Utah Code 1994b) and ring-necked pheasants (*Phasianus colchicus*; Chap-ter 46, Utah Code 1971).

We surveyed Utah alfalfa growers to deter-mine their perceptions regarding wildlife damage to hay crops. Such surveys can provide wildlife managers with important information regarding landowner wildlife damage manage-ment needs and concerns (Conover 1994).

METHODS

We surveyed 334 alfalfa growers (4% of all alfalfa growers in Utah) whose names were on the Utah Department of Agriculture's (UDA) 1993 Hay List. The UDA maintains this list to provide information to individuals who contact the department about purchasing alfalfa hay in Utah. The UDA updates this list each January.

We included a 2-page wildlife damage survey in a UDA mailing sent to the growers. In addition to the survey, growers received a cover letter, the UDA's questionnaire, and a business reply envelope. The cover letter stated that if no response was received within 30 d, the grower's name would be removed from the hay list. A follow-up letter was sent to nonrespon-dents 3 wk after the initial mailing. Those fail-ing to respond to the 2nd mailing were removed from the hay list.

The survey contained questions about the growers' experiences with wildlife in their alfalfa crops. Growers were asked to identify wildlife species causing damage to hay crops, type of damage, their annual monetary loss from wild-life damage, specific damage control techniques employed on their farm to control wildlife damage, whether they received any type of damage compensation or assistance, who they contacted for assistance and information, and what type of information and programs they found most useful in managing wildlife damage. Further, growers were asked to rate on a scale of 0 to 5 (0 = no cost through 5 = high cost) relative losses caused by different wildlife species to their alfalfa crops and the costs associated with

common management practices used on their farms and ranches.

Responses were stratified and analyzed by the number of hectares in alfalfa (0–40, 41–80, 81–200, 201–400, and >400) and type of oper-ation (irrigated or dryland). Levene's tests were used to determine equality of variances by types and sizes of alfalfa operation (SPSS 1995).

We assumed that alfalfa growers on the hay list have the same values and perceptions as the population of Utah alfalfa growers. To deter-mine if the hay list was statistically representa-tive of Utah alfalfa growers, we compared the mean alfalfa farm size and regional distribu-tions of farms on the hay list with acreage cate-gories reported by the UDA for all Utah alfalfa farms (Gneiting 1994) using a Kruskal-Wallis one-way analysis of variance. Differences in these tests were considered significant if $P < 0.05$.

RESULTS

Alfalfa Production

One hundred sixty-four completed ques-tionnaires (49.1%) were returned, of which 150 (91%) were useable for analysis. Survey respon-dents reported growing 16,867 ha of alfalfa, of which 14,391 ha (85%) was irrigated and 2486 ha (15%) was dryland alfalfa. Irrigated alfalfa farms ranged in size from 5 to 1062 ha. Dry-land alfalfa farms ranged in size from 3 to 320 ha. All farms were family owned and operated.

Since the UDA hay list is relatively dynam-ic, it contains information regarding the grower's mailing address, telephone number, and inter-est in selling alfalfa hay, but not the size and type of operation. Information on alfalfa opera-tions was obtained through the survey; thus, we were unable to determine if there were any significant differences between respondents and nonrespondents.

Although the responses received consti-tuted 2% of all Utah alfalfa growers ($N = 7600$), our sample was representative of the popula-tion based on mean farm size ($H = 7.0$; 7 df; $P = 0.001$) and regional distribution. Utah alfalfa acreage percentages reported by the UDA for northern, central, eastern, and southern regions were 30%, 31%, 19%, and 20%, respectively (Gneiting 1994). Regional alfalfa acreage per-centages for our sample were northern 27%, central 34%, eastern 21%, and southern 18%.

Wildlife Species Present in Utah Alfalfa Fields

Respondents reported 20 different species of wildlife were present in their alfalfa fields. Pocket gophers and mule deer were the most abundant, being reported present on 124 (82.7%) and 120 (80.0%) farms, respectively. Other wildlife species reported by farmers as common in alfalfa fields included jackrabbits (*Lepus* spp.; $n = 89$, 59.3%), ground squirrels (*Spermophilus* spp.; $n = 83$, 55.3%), prairie dogs (*Cynomys* spp.; $n = 69$, 46.0%), waterfowl (*Anatidae*; $n = 66$, 44.0%), elk (*Cervus elaphus*; $n = 62$, 41.3%), pronghorn (*Antilocapra americana*; $n = 54$, 36.0%), and voles (*Microtus* spp.; $n = 50$, 33.3%). Wildlife species reported by farmers as being less common in alfalfa fields included marmots (*Marmota flaviventris*), badgers (*Taxidea taxus*), red foxes (*Vulpes vulpes*), sandhill cranes (*Grus canadensis*), Canada geese (*Branta canadensis*), cottontail rabbits (*Sylvilagus* spp.), deer mice (*Peromyscus maniculatus*), raccoons (*Procyon lotor*), ring-necked pheasants, and muskrats (*Ondatra zibethica*).

Monetary Losses Caused by Wildlife

One hundred nine growers (72%) reported losing \$350,000 ($\bar{x} = \3242, $s_{\bar{x}} = 526$) because of wildlife damage in their alfalfa fields. Monetary losses averaged \$24.79/ha.

The average dollar loss reported by respondents who grew only irrigated alfalfa was \$3016 ($n = 86$, $s_{\bar{x}} = 554$). Respondents who grew both irrigated and dryland alfalfa reported an average loss of \$4388 ($n = 21$, $s_{\bar{x}} = 1525$). Those who grew only dryland alfalfa reported an average loss of \$3750 ($n = 2$, $s_{\bar{x}} = 250$).

The highest losses per/ha were reported by respondents who grew both irrigated and dryland alfalfa (\$42/ha). Respondents who grew only irrigated or dryland alfalfa reported losses per/ha of \$19 and \$28, respectively.

Growers with irrigated alfalfa farms >200 ha in size reported significantly higher monetary losses than operations <200 ha in size ($F = 15.5$; 1,103 df; $P < 0.001$). Although the average monetary loss reported by larger alfalfa farms was \$5078 ($n = 50$) compared to \$1639 for smaller farms ($n = 55$), the average loss per/ha was higher on smaller (\$37) than larger farms (\$21; $F = 24.9$; 1,103 df; $P < 0.001$). Growers reported no significant difference in

damage losses by size for irrigated/dryland alfalfa farms ($F = 0.4$; 1,26 df; $P = 0.52$).

Respondents with alfalfa farms >80 ha reported that rodents ($F = 7.9$; 1,107 df; $P = 0.006$) and ungulates ($F = 18.2$; 1,107 df; $P < 0.001$) caused higher monetary losses when compared to smaller farms (<80 ha). No significant differences in monetary losses due to waterfowl were detected by alfalfa farm size ($F = 0.006$; 1,107 df; $P = 0.940$).

Relative Costs of Wildlife Damage in Alfalfa Fields

Respondents ranked on a scale of 0–5 (0 = no cost through 5 = high cost) the relative damage costs associated with common wildlife species reported in their alfalfa fields as follows: mule deer (2.9), pocket gophers (2.4), elk (1.6), prairie dogs (1.4), ground squirrels (1.4), jackrabbits (1.3), waterfowl (1.0), pronghorn (0.7), and meadow voles (0.9). Respondents with irrigated alfalfa farms >200 ha reported that elk ($F = 7.9$; 1,56 df; $P = .007$) and pronghorn ($F = 7.5$; 1,48 df; $P = .008$) caused significantly greater cost-related problems than on smaller farms (<200 ha). Respondents with dryland alfalfa farms >200 ha reported greater significant cost-related problems caused by jackrabbits ($F = 14.1$; 1,20 df; $P = 0.001$) and mule deer ($F = 8.5$; 1,28 df; $P = 0.007$) than on smaller farms (<200 ha). Survey respondents indicated that alfalfa production problems differed by specific wildlife species (Table 1).

Farm and Ranch Management Practice Comparisons

Respondents ranked on a scale of 0–5 (0 = no cost through 5 = high cost) the relative cost of the 7 farm management practices as follows: irrigation (3.8), fertilization (3.4), weed control (2.9), insect control (2.6), fencing (2.3), big game control (2.0), and rodent/rabbit control (1.9). Fertilization, weed control, and irrigation were used on 82%, 81%, and 80% of the farms, respectively. Big game and rodent/rabbit control were used by 71% and 38% of the respondents, respectively. Respondents also reported employing several techniques to control wildlife damage in alfalfa fields (Table 2). Based on sizes and types of alfalfa operations, the only significant cost differences reported by management practices were for irrigation on farms >200 ha ($F = 5.0$; 1,124 df; $P = 0.03$).

TABLE 1. Percentage of all respondents ($N = 150$) reporting problems caused by a specific wildlife species in Utah alfalfa fields in 1993 and a breakdown of that percentage into subcategories based on the most severe type of problem caused.

Wildlife species causing damage	Reporting problems (%)	Percentage identifying a specific problem as most severe			
		Hay quality	Hay quantity	Equipment damage	Increased costs
Pocket gophers	68.7	14.0	20.7	26.0	8.0
Ground squirrel	33.3	4.0	10.7	15.3	3.3
Voles	10.7	2.7	6.7	1.3	0.0
Jackrabbits	32.8	2.7	28.7	0.7	0.7
Prairie dogs	23.3	0.7	8.0	13.3	1.3
Elk	20.0	6.0	12.7	1.3	0.0
Mule deer	64.0	8.7	54.0	1.3	0.0
Antelope	9.3	1.3	8.0	0.0	0.0
Waterfowl	17.3	2.7	14.7	0.0	0.0

Wildlife Damage Management Assistance Programs

Fourteen respondents (9%) reported receiving compensation for wildlife damage in their alfalfa fields. Of these, 12 received compensation for damage caused by mule deer. Another 48 (31%) indicated they received some type of technical assistance to control wildlife damage. Most of this assistance (75%) was provided to control damage caused by mule deer.

One hundred twenty-two respondents (80%) reported seeking either information or assistance in dealing with wildlife depredation problems. Conservation officers were cited by 53 growers (43%) as being their primary contact for information or assistance. County agents and UDWR biologists ranked 2nd (22%) and 3rd (18%), respectively. Other sources of information in order of decreasing importance were other landowners (7%), farm and ranch stores (5%), and UDA agricultural representatives (3%).

Respondents preferred compensations and incentive programs (42%) to other types of programs to manage damage caused by wildlife in alfalfa fields. Research (17%), field demonstrations (13%), workshops (13%), facts sheets (13%), and videos (14%) were rated nearly equal in usefulness.

DISCUSSION

Relationship of Perceived Damage Costs to Wildlife Management

Surveys can be cost-effective means of assessing the magnitude and economic impact of wildlife depredation (Crabb et al. 1986). Unfortunately, due to the cost and time associated with conducting reliable surveys, many wildlife

agencies are unable to perform this work on a regular basis. Our experience suggests that wildlife agencies should consider using state agriculture department hay lists to conduct benchmark surveys to identify wildlife damage management concerns and needs. Most states maintain hay lists (R. Parker, personal communication, UDA, 1995).

Our results summarize perceived losses. The relationship between perceived and actual losses is unclear and probably difficult to estimate (Conover 1994). This relationship depends in part on how conspicuous the damage appears and which wildlife species causes the damage (Wakeley and Mitchell 1981, Decker et al. 1984, McIvor and Conover 1994b).

Most respondents reported problems with pocket gophers and mule deer. Other species commonly causing problems included jackrabbits, ground squirrels, prairie dogs, waterfowl, elk, pronghorn, and meadow voles. Conover (1994) also found that these species, in particular deer, were perceived to cause most damage to agricultural crops in the U.S.

Based on statewide averages, in 1993 Utah alfalfa growers harvested 10.5 tons/ha with a market value of \$71.66 a ton. Survey respondents produced 177,104 tons of alfalfa on 16,867 ha having a total value of \$12,691,000. The \$350,000 loss reported due to wildlife represents 2.8% of the crop value. Expanding this to the total value of alfalfa produced in Utah during 1993 results in a total perceived loss of \$4.4 million. This is 9 times the amount the Utah State Legislature annually appropriates (\$500,000) to reimburse crop owner depredation claims and expenses (Chapter 307, Utah Code 1994b).

TABLE 2. Percentage of all respondents ($N = 150$) using a specific technique to control damage caused by wildlife species in Utah alfalfa fields in 1993 and a breakdown of that percentage into subcategories based on the most effective technique used.

Wildlife species causing damage	Using damage control techniques (%)	Percentage identifying a specific technique as being most effective						
		Trapping	Shooting/hunting	Poison baits	Fumigants	Cultural	Fencing	Hazing
Pocket gopher	41.7	6.7	0.0	33.0	2.0	0.0	0.0	0.0
Ground squirrel	45.4	4.7	17.3	22.0	0.0	0.7	0.0	0.7
Voies	13.3	2.0	2.7	7.3	0.0	1.3	0.0	0.0
Jackrabbits	39.3	0.0	36.0	2.7	0.0	0.0	0.7	0.0
Prairie dogs	24.0	2.0	12.7	7.3	1.3	0.0	0.7	0.0
Elk	21.3	0.0	12.0	0.0	0.7	0.0	7.3	1.3
Mule deer	46.7	0.0	22.7	0.0	0.7	0.0	16.0	7.3
Antelope	9.7	0.0	4.0	0.0	0.7	0.0	2.7	1.3
Waterfowl	16.7	0.0	13.3	0.7	0.7	0.0	0.0	2.0

Utah Code authorizes the UDWR to immediately pay any approved damage claims \leq \$500. Claims or total amounts of claims submitted by a claimant in the fiscal year that are $>$ \$500 are not paid until the total amount of approved claims for the fiscal year is determined. If the amount claimed exceeds the appropriation, the per claimant amounts paid in excess of \$500 are prorated. The current appropriation falls short of satisfying wildlife damage compensation claims and expenses (R. Valentine, personal communication, UDWR, 1996).

If 13% of Utah alfalfa growers ($n = 1000$) submitted approved claims of \$500, their claims would deplete the annual appropriation. Although the alfalfa growers we surveyed preferred compensation and incentive payments over other types of wildlife damage management programs, only 9% had ever received any financial support.

In the United States, 2.1 million farmers control 400 million ha of our 937 million ha land base. Their actions largely influence the quality and quantity of the existing wildlife habitat base (Gerard 1995). Landowners' perceptions and concerns about wildlife damage are important because they influence their attitudes and behavior toward wildlife. Conover (1994) suggested that wildlife damage has reached levels that discourage private landowners from managing for wildlife on their property. Our results suggest that Utah alfalfa growers also perceive wildlife damage in alfalfa fields as a serious concern. Although wildlife professionals working for federal or state wildlife and agricultural agencies believe that wild-

life damage has increased in the last 30 yr, our survey results reinforce Conover and Decker's (1991) suggestion that programs necessary to adequately address crop owner concerns have not yet been implemented.

Role of State Agencies in Resolving Wildlife Damage Management Concerns

State wildlife management agencies are responsible for managing damage caused by big game, upland game, and waterfowl (Musgrave and Stein 1993). State agriculture departments administer and enforce pesticide control legislation that regulates the safe and proper use of pesticides for vertebrate pest damage. Because of this role, agriculture departments have jurisdiction over the control of unprotected wildlife species (vertebrate pests). In Utah these include pocket gophers, field mice, muskrats, ground squirrels, jackrabbits, raccoons, skunks, red fox, and coyotes.

The UDWR recognizes that private lands within Utah provide habitat for wildlife and that under some circumstances wildlife may cause economic losses to the landowner. With this understanding, the UDWR cooperates with the UDA and the U.S. Department of Agriculture Animal Plant Health and Inspection Service/Animal Damage Control (ADC) program to conduct predator, bird, and rodent control activities and compensate landowners for certain losses caused by wildlife using funds appropriated by the legislature.

In 1994 the Utah legislature enacted an alternative compensation program that allows landowners to receive permits to harvest antlerless animals as mitigation for damage caused

by big game (Chapter 176, Utah Code 1994a). In 1995 the UDWR Southern Region issued >1200 mitigation permits, of which 50% were filled. In 1996 both the number of tags issued and number of animals harvested declined as landowners lost interest in the program (N. McKee, personal communication, UDWR, 1996).

To better address landowners' concerns given fiscal and legal constraints, we suggest that agencies and organizations responsible for managing wildlife resources and wildlife damage on Utah agricultural lands collaborate to develop strategies that allow profitable agriculture and wildlife to coexist. Utah's posted hunting unit (PHU; Chapter 288, Utah Code 1993b) and wildlife habitat authorization (WHA) programs (Chapter 75, Utah Code 1995) may offer additional mechanisms to achieve this goal.

The Posted Hunting Unit Program

The UDWR also recognizes that wildlife can be a significant benefit to the landowner. The PHU program provides landowners with monetary incentives, through an allocation of hunting permits, to include wildlife (small game, waterfowl, and big game) in farm and ranch management plans. Landowners who participate in the program are required to improve wildlife habitat but are ineligible to receive compensation for crop losses caused by wildlife.

The most successful of Utah's PHU programs involves big game animals. In 1994, 47 big game PHU programs, encompassing over 400,000 ha of private land, provided additional economic returns for hundreds of landowners and hunting experiences for thousands of hunters. Current program guidelines limit participation to landowners or landowner groups who own at least 4000 ha (Chapter 288, Utah Code 1993b). The size limitation was established to create more manageable herd units.

In our survey, respondents reported that big game animals caused the greatest damage. We suggest that big game PHU guidelines be modified to accommodate farm or ranch units <4000 ha in size. This modification would provide the stimulus necessary to alleviate many crop owners' wildlife damage concerns and provide an additional incentive to include wildlife in farm and ranch management plans. In addition, we suggest that big game PHU operators be encouraged to incorporate provisions in their wildlife management plans to compen-

sate smaller nonparticipating landowners adjacent to their operation for crop damage caused by big game animals.

The Wildlife Habitat Authorization Program

The WHA program requires persons 14 yr of age or older to purchase a wildlife habitat authorization prior to purchasing certain hunting or fishing licenses or permits. The funds generated from this authorization are placed into a restricted account to be used for wildlife habitat improvements. Several other Great Basin states operate similar programs designed to generate funds to do habitat work.

We recommend that state wildlife agencies consider using habitat funds to implement and evaluate enhancement projects and programs on public and private land that are designed specifically to reduce big game depredation on private land. Habitat funds could be used to establish big game lure crops, situate interceptor strips, or modify migration corridors as a means of abating localized depredation problems.

Wildlife Damage Education Needs

Crop owners also need additional information on techniques used to manage wildlife damage. Several respondents reported using fumigants and poison baits to control damage caused by ungulates, lagomorphs, and birds. These practices are illegal, as no products are currently registered in the U.S. to control damage caused by these species.

We recommend that state wildlife agencies, agriculture departments, and federal ADC programs cooperate in the development of public outreach, extension education, and research activities intended to inform crop owners about techniques that can be used to manage wildlife damage. These programs also should provide information on conservation technologies, non-lethal strategies, and opportunities that can be used to control wildlife damage and benefit wildlife resources while maintaining or enhancing agricultural profitability.

In conclusion, previous studies conducted in the Great Basin focused on evaluating the effects of big game depredation (Tebaldi and Anderson 1982, Austin and Urness 1987a, 1987b, 1989, 1993) and sandhill cranes (Melvor and Conover 1994b) on agricultural production. Our study adds to this research by providing important insights regarding crop owners'

perceptions about wildlife damage and their needs and preferences in managing damage.

Our results suggest that Utah alfalfa growers perceive wildlife damage as a serious concern. This concern should be shared by wildlife managers.

In addition to informing landowners of their concern over wildlife damage, wildlife managers should demonstrate it by addressing potentials for increasing damage on private lands when developing wildlife habitat management plans (Conover 1994). Wildlife managers also should incorporate strategies in management plans to benefit wildlife and reduce depredation potentials on private land.

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LITERATURE CITED

- AUSTIN, D. A., AND P. J. URNESS. 1987a. Consumption of fresh alfalfa hay by mule deer and elk. *Great Basin Naturalist* 47: 100-102.
- _____. 1987b. Guidelines for evaluating annual crop losses due to depredating big game. Utah Division of Wildlife Resources, Publication 87-5. 42 pp.
- _____. 1989. Evaluating production losses from mule deer depredation in apple orchards. *Wildlife Society Bulletin* 17: 161-165.
- _____. 1993. Evaluating production losses from mule deer depredation in alfalfa fields. *Wildlife Society Bulletin* 21: 397-401.
- CONOVER, M. R. 1994. Perceptions of grass-roots leaders of the agricultural community about wildlife damage on their farms and ranches. *Wildlife Society Bulletin* 22: 94-100.
- CONOVER, M. R., AND D. J. DECKER. 1991. Wildlife damage to crops: perceptions of agricultural and wildlife professionals in 1957 and 1987. *Wildlife Society Bulletin* 19: 46-52.
- CRABB, A. C., T. P. SALMON, AND R. E. MARSH. 1986. Surveys as an approach to gathering animal damage information. Pages 2-4 in *Vertebrate pest control and management materials*. American Society for Testing and Materials STP 974, Philadelphia, PA. 12 pp.
- DECKER, D. J., G. F. MATTFIELD, AND T. L. BROWN. 1984. Influence of deer damage on farmers' perceptions of deer population trends: important implications for managers. *Proceedings of the First Eastern Wildlife Damage Control Conference* 1: 191-195.
- DUNN, J. P., J. A. CHAPMAN, AND R. E. MARSH. 1982. Jack-rabbits. Pages 124-145 in *Wild mammals of North America: biology, management and economics*. John Hopkins University Press, Baltimore, MD. 1147 pp.
- GERARD, P. W. 1995. Agricultural practices, farm policy, and the conservation of biological diversity. *Biological Science Report* 4. U.S. Department of Interior, National Biological Service, Washington, DC. 25 pp.
- GNETTING, D. J. 1994. Utah agricultural statistics. Utah Agricultural Statistics Service and the Utah Department of Agriculture, Salt Lake City. 138 pp.
- LEWIS, S. R., AND J. M. O'BRIEN. 1990. Survey of rodent and rabbit damage to alfalfa hay in Nevada. Pages 166-117 in *Proceedings of the 14th Vertebrate Pest Conference*. University of California, Davis. 320 pp.
- LUCE, D. G., R. M. CASE, AND J. L. STUBBENDIECK. 1981. Damage to alfalfa fields by plains pocket gophers. *Journal of Wildlife Management* 45: 258-260.
- MCIVOR, D. E., AND M. R. CONOVER. 1994a. Perceptions of farmers and non-farmers toward management of problem wildlife. *Wildlife Society Bulletin* 22: 211-219.
- _____. 1994b. Impact of Greater Sandhill Cranes foraging on corn and barley crops. *Agriculture, Ecosystems, and Environment* 49: 233-237.
- MUSGRAVE, R. S., AND M. A. STEIN. 1993. *State wildlife laws handbook*. Center for Wildlife Law, Institute of Public Law, University of New Mexico, Albuquerque. 840 pp.
- NATIONAL AGRICULTURAL STATISTICS SERVICE. 1995. 1994 crop statistics. U.S. Department of Agriculture, Washington, DC.
- PACKAM, C. J., AND G. CONNOLLY. 1992. Control methods research priorities for animal damage control. Pages 12-16 in *Proceedings of the 15th Vertebrate Pest Conference*. University of California, Davis. 300 pp.
- PIPER, S. E. 1909. The Nevada mouse plague of 1907-08. *Farmers Bulletin* 352: 1-23.
- RENNISON, B. D., AND A. P. BUCKLE. 1988. Methods for estimating the losses caused in rice and other crops by rodents. Pages 69-80 in *Rodent pest management*. CRC Press Inc., Boca Raton, FL. 238 pp.
- SAUER, W. C. 1978. Control of the Oregon ground squirrel. Pages 99-109 in *Proceedings of the 7th Vertebrate Pest Conference*. University of California, Davis. 323 pp.
- STATISTICAL PROGRAMS FOR SOCIAL SCIENCES. 1995. *Microsoft Windows Release 5.0*. Microsoft Corporation, Redmond, WA.
- TEBALDI, A., AND C. C. ANDEBSON. 1982. Effects of deer use on winter wheat and alfalfa production. Wyoming Fish and Game Department. Job Final Report FW-3-R-26. 78 pp.
- UTAH CODE. 1971. Chapter 46. Section 23-17-5. Damages for destroyed crops—Limitations—Appeal.
- _____. 1993a. Chapter 183. Section 23-16-3. Damage to cultivated crops by big game animals—Notice to division—Crop owner authorized to kill animals.
- _____. 1993b. Chapter 288. Section 23-23-1. Posted hunting units.
- _____. 1994a. Chapter 176. Section 23-16-3.5. Damages to livestock forage, fences, or irrigation equipment on private land.
- _____. 1994b. Chapter 307. Section 23-16-4. Damages for destroyed crops—Limitations—Appraisal.
- _____. 1995. Chapter 75. Section 23-19-42. Wildlife habitat authorization.
- WAKELEY, J. S., AND R. C. MITCHELL. 1981. Blackbird damage to ripening field corn in Pennsylvania. *Wildlife Society Bulletin* 9: 52-55.